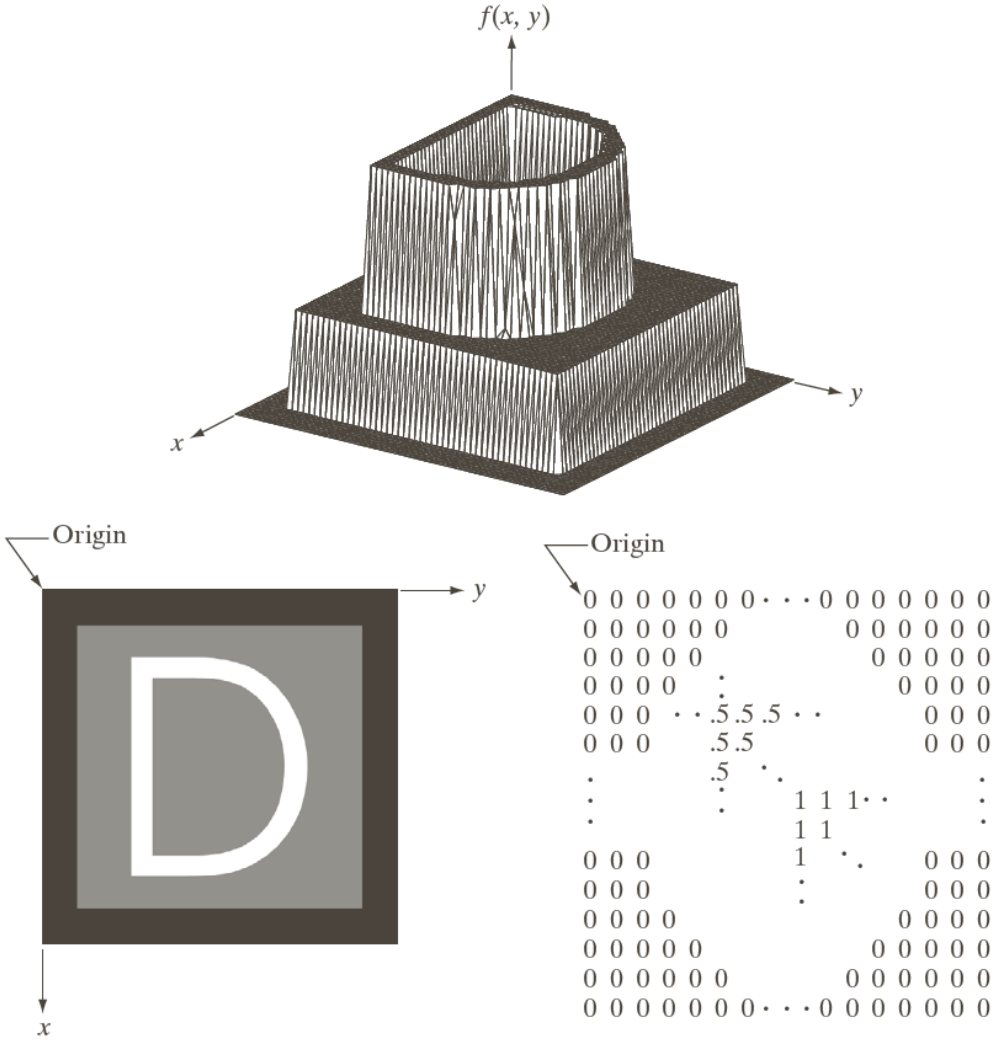
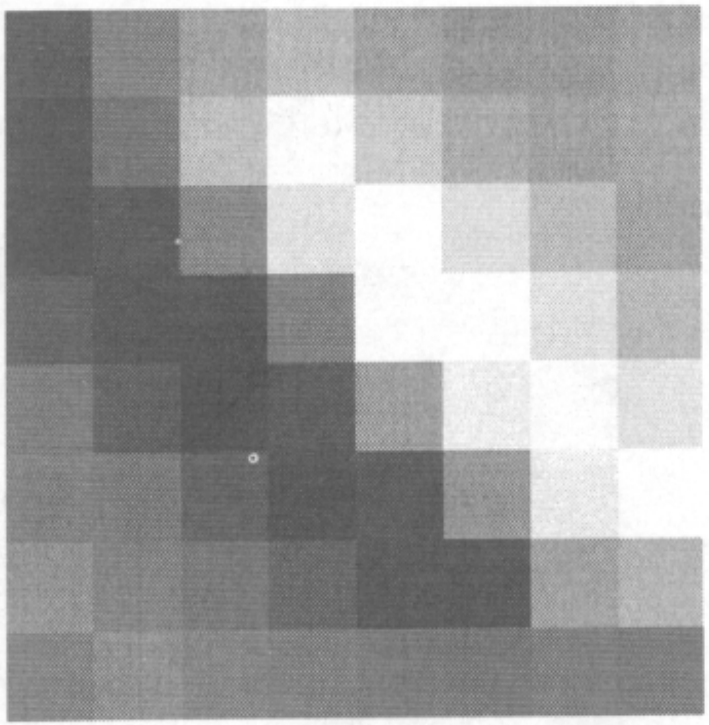
Representation of digital images



a
b c

FIGURE 2.18
(a) Image plotted as a surface.
(b) Image displayed as a visual intensity array.
(c) Image shown as a 2-D numerical array (0, .5, and 1 represent black, gray, and white, respectively).

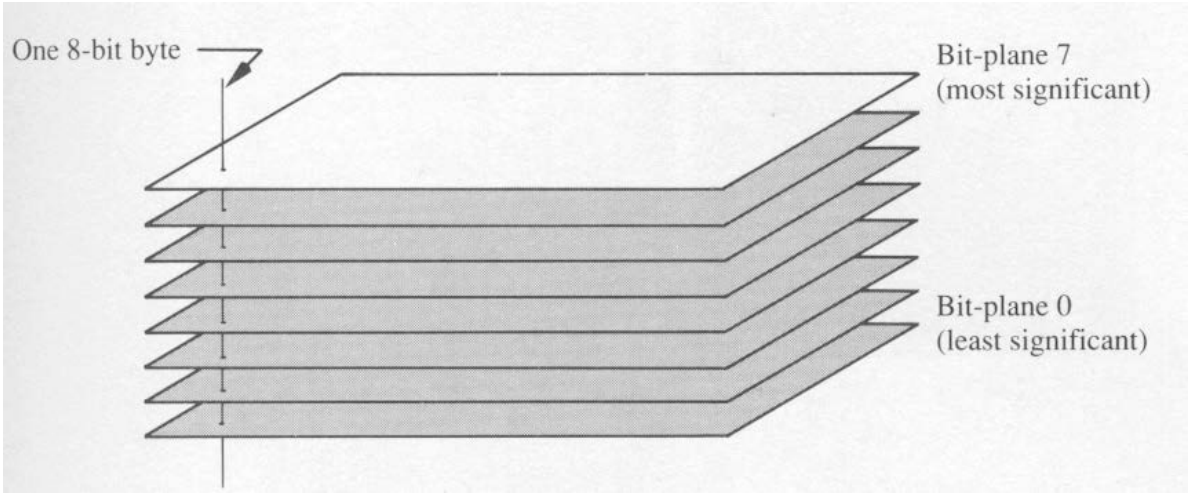
Another digital image



20	128	180	220	180	160	165	160
20	25	128	230	250	240	220	150
20	25	128	230	250	240	220	160
25	20	15	120	245	250	240	170
110	25	20	25	180	230	255	240
135	125	30	20	30	180	245	250
120	128	120	80	20	25	150	170
110	128	110	120	110	100	120	110

The Digital Image

$2^7 = 128$	$2^6 = 64$	$2^5 = 32$	$2^4 = 16$	$2^3 = 8$	$2^2 = 4$	$2^1 = 2$	$2^0 = 1$
Bit 7 (MSB)	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0 (LSB)



1 Bit : max value = $1 = 2^1 - 1$

1 Byte = 8 bits : max value = $255 = 2^8 - 1$

1 Word = 2 bytes = 16 bits : max value = $65535 = 2^{16} - 1$

Representation of digital images

$$f(x,y) = \begin{bmatrix} f(0,0) & f(0,1) & \dots & f(0,N-1) \\ f(1,0) & f(1,1) & \dots & f(1,N-1) \\ \vdots & \vdots & & \vdots \\ f(M-1,0) & f(M-1,1) & \dots & f(M-1,N-1) \end{bmatrix}$$

$$A = \begin{bmatrix} a_{0,0} & a_{0,1} & \dots & a_{0,N-1} \\ a_{1,0} & a_{1,1} & \dots & a_{1,N-1} \\ \vdots & \vdots & & \vdots \\ a_{M-1,0} & a_{M-1,1} & \dots & a_{M-1,N-1} \end{bmatrix}$$

$$a = \begin{bmatrix} a_{0,0} & a_{0,1} & \dots & a_{0,N-1} & \dots & a_{M-1,N-1} \end{bmatrix}$$

$$v = \begin{bmatrix} v_0 & v_1 & \dots & v_{N-1} & \dots & v_{MN-1} \end{bmatrix}$$

Representation of digital images

$$f(x,y) = \begin{bmatrix} f(0,0) & f(0,1) & \dots & f(0,N-1) \\ f(1,0) & f(1,1) & \dots & f(1,N-1) \\ \vdots & \vdots & & \vdots \\ f(M-1,0) & f(M-1,1) & \dots & f(M-1,N-1) \end{bmatrix}$$

Pixel location

$$A = \begin{bmatrix} a_{0,0} & a_{0,1} & \dots & a_{0,N-1} \\ a_{1,0} & a_{1,1} & \dots & a_{1,N-1} \\ \vdots & \vdots & & \vdots \\ a_{M-1,0} & a_{M-1,1} & \dots & a_{M-1,N-1} \end{bmatrix}$$

$$a = \begin{bmatrix} a_{0,0} & a_{0,1} & \dots & a_{0,N-1} & \dots & a_{M-1,N-1} \end{bmatrix}$$

$$v = \begin{bmatrix} v_0 & v_1 & \dots & v_{N-1} & \dots & v_{MN-1} \end{bmatrix}$$

Representation of digital images

$$f(x,y) = \begin{bmatrix} f(0,0) & f(0,1) & \dots & f(0,N-1) \\ f(1,0) & f(1,1) & \dots & f(1,N-1) \\ \vdots & \vdots & & \vdots \\ f(M-1,0) & f(M-1,1) & \dots & f(M-1,N-1) \end{bmatrix}$$

Pixel location

$$A = \begin{bmatrix} a_{0,0} & a_{0,1} & \dots & a_{0,N-1} \\ a_{1,0} & a_{1,1} & \dots & a_{1,N-1} \\ \vdots & \vdots & & \vdots \\ a_{M-1,0} & a_{M-1,1} & \dots & a_{M-1,N-1} \end{bmatrix}$$

$$a = \begin{bmatrix} a_{0,0} & a_{0,1} & \dots & a_{0,N-1} & \dots & a_{M-1,N-1} \end{bmatrix}$$

Represents an intensity (pixel)value

$$v = \begin{bmatrix} v_0 & v_1 & \dots & v_{N-1} & \dots & v_{MN-1} \end{bmatrix}$$

```
I=zeros(16)
I(4:7,4:7)=1
I(10:13,10:13)=0.5
bar3(I,'w')

figure
imshow(I)
imwrite(I,'theimage.png','png')
J=imread('theimage.png')
```

Acknowledgement

- All figures are from Gonzalez, R. C. and Woods, R. E., *Digital Image Processing*, 3rd Ed., 2008, Prentice Hall and Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, 2nd ed.